

## A new species of *Simulium* (*Simulium*) (Diptera: Simuliidae) from Luzon Island, Philippines

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**Abstract:** *Simulium* (*Simulium*) *arboreum* sp. nov. is described based on the female reared from a pupa collected from Luzon Island, Philippines. This new species is characterized by the pupal gill with an arborescent type of 38 slender filaments, a character never found in the subgenus *Simulium* s. str. in the Oriental Region.

Key words: black fly, Simuliidae, *Simulium*, Philippines, new species

In the Philippines, a total of 59 black-fly species, all in the genus *Simulium* Latreille s. l., have been reported, of which 24 are classified in the subgenus *Simulium* s. str. (Takaoka, 1983, 2000, 2005).

Recently, one more species of this subgenus was collected from Ifugao province in Luzon, which is very distinctive among the Simuliidae in the Oriental Region because it has the pupal gill of an arborescent type of 38 slender filaments. This is here described as a new species based on the female and its pupal exuviae.

The terms for morphological features used here follow those of Takaoka (2003). Holotype specimen of the new species is deposited at the Department of Infectious Disease Control, Oita University.

### *Simulium* (*Simulium*) *arboreum* sp. nov.

**DESCRIPTION. Female.** Body length 2.6 mm. **Head.** Slightly narrower than thorax. Frons brownish-black, shiny, widely bare and with several dark long and stout hairs along lateral margin and just above antennal base on each side; median suture on lower portion absent; frontal ratio 1.2 : 1.0 : 1.0. Frons-head ratio 1.0 : 3.8. Fronto-ocular area (Fig. 1A) well developed, short, triangular, directed laterally. Clypeus brownish-black, whitish pruinose,

slightly shiny at certain angle of light, moderately covered with dark long and stout hairs except median portion bare longitudinally on upper 3/4. Labrum 0.75 times as long as clypeus. Antenna composed of 2+9 segments, dark brown, except scape and pedicel dark yellow or light brown. Maxillary palp consisting of 5 segments, light to medium brown, proportional lengths of 3rd, 4th, and 5th segments 1.0 : 1.0 : 2.2; 3rd segment not enlarged; sensory vesicle (Fig. 1B) ellipsoidal, 0.33 times as long as 3rd segment, with opening of moderate size. Lacinia with 9 inner and 11–13 outer teeth. Mandible with 26 inner and 11 or 12 outer teeth. Cibarium (Fig. 1C) with several small processes near posterior margin. **Thorax.** Scutum dark brown to brownish-black, white pruinose, shiny and densely covered with dark short hairs mixed with several dark upright long hairs on prescutellar area; scutum without marked color pattern though 1 median and 2 submedian longitudinal vittae very faintly visible at certain angle of light. Scutellum dark brown, white pruinose, with many dark upright long hairs. Postnotum dark brown, white pruinose, slightly shiny at certain angle of light, bare. Pleural membrane bare. Katepisternum longer than deep, medium brown, shiny in light and bare. Furcasternum with distinct ventrally-directed apodeme on each internal dorsal arm. **Legs.** Foreleg: coxa yellowish-white; trochanter yellow; femur light to medium brown except basal 1/4 yellow

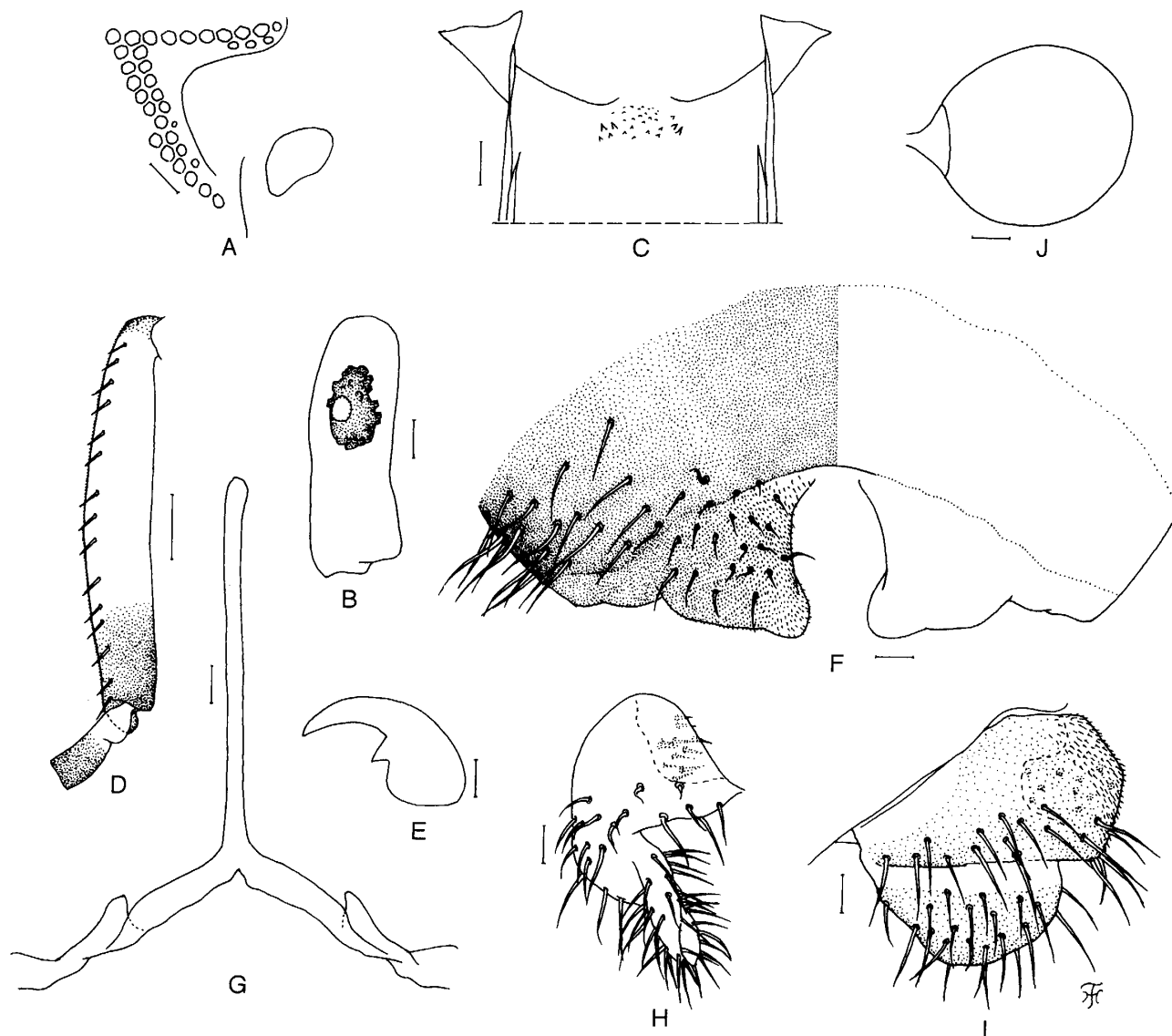


Fig. 1. Adult female of *Simulium (Simulium) arboreum* sp. nov. A, fronto-ocular area (right side, frontal view); B, 3rd maxillary palpal segment with sensory vesicle (right side, front view); C, upper portion of cibarium (front view); D, hind basitarsus and 2nd tarsal segment (left side, outer view); E, claw; F, 8th sternite and ovipositor valves *in situ* (ventral view); G, genital fork (ventral view); H and I, paraprocts and cerci (right side; H, ventral view; I, lateral view); J, spermatheca. Scales. 0.1 mm for D; 0.03 mm for A; 0.02 mm for B, C and F-J; 0.01 mm for E.

though its border not well defined; tibia yellowish-white except apical cap medium brown, with moderate dorsal crest of dark short hairs on segments 1-3; basitarsus moderately dilated, 5.5 times as long as its greatest width. Midleg: coxa dark brown; trochanter medium brown except base yellowish-white; femur medium brown except apical cap dark brown; tibia yellowish-white except apical 1/4 medium brown, and with white sheen on posterior surface when illuminated at certain angle of light; tarsus medium brown except basal 3/4 of basitarsus and base of 2nd segment

yellowish-white. Hind leg: coxa medium to dark brown; trochanter yellow; femur medium brown except base yellow and apical cap dark brown; tibia yellowish-white except a little less than apical 1/2 medium to dark brown, and with white sheen on posterior surface when illuminated at certain angle of light; tarsus medium brown except basal 3/4 of basitarsus and basal 1/2 of 2nd segment yellowish-white; basitarsus (Fig. 1D) very slightly widened from base to middle, then slightly narrowed toward apex, 6.3 times as long as its greatest width, 0.7 times and 0.6 times as wide as greatest widths

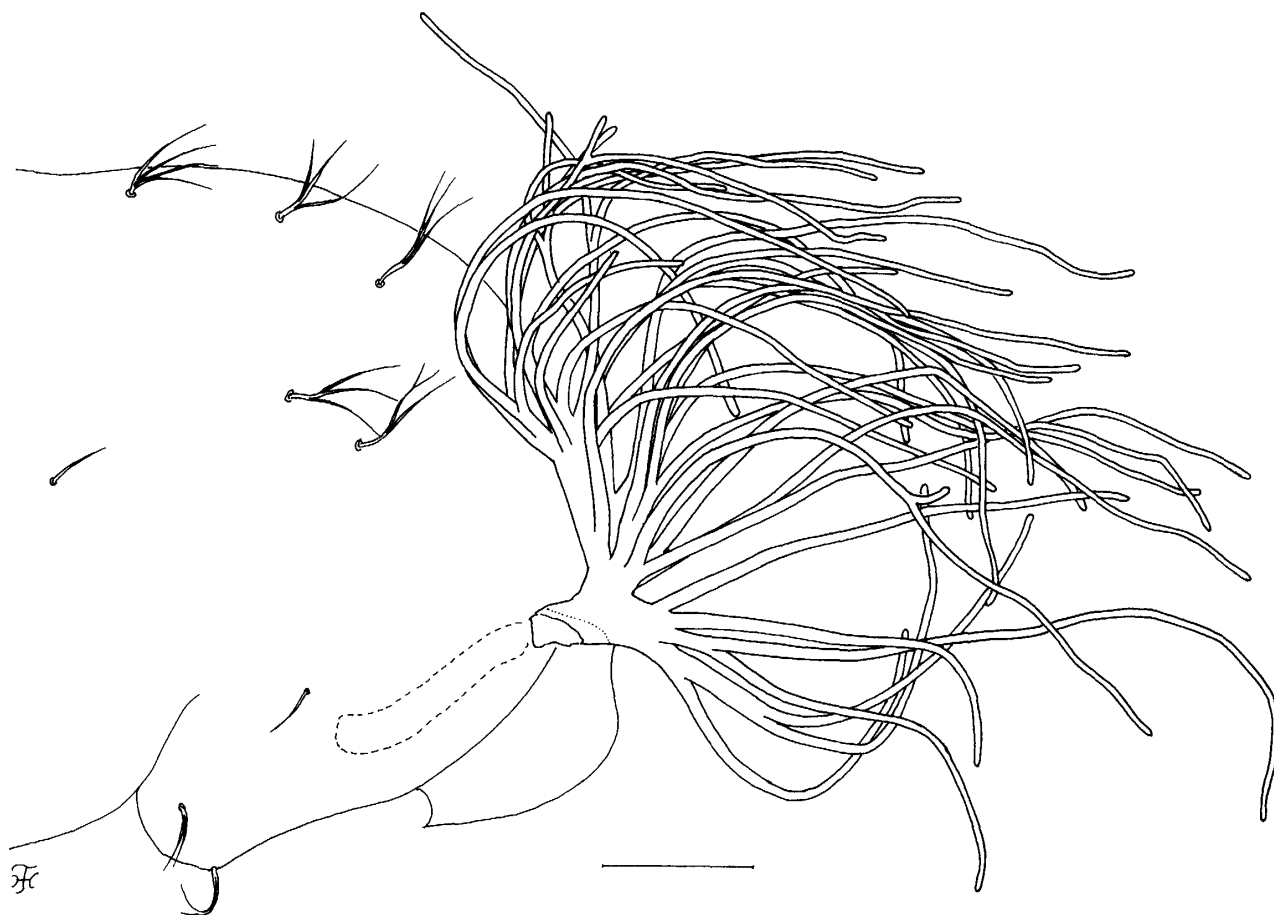


Fig. 2. Pupa of *Simulium* (*Simulium*) *arboreum* sp. nov. Anterior 1/2 of thorax with gill filaments (right side, outer view). Scale. 0.2 mm.

of tibia and femur, respectively; calcipala well developed, slightly shorter than its width at base, and 0.44 times as wide as greatest width of basitarsus; pedisulcus well developed. Claw (Fig. 1E) with small subbasal tooth. **Wing.** Length 2.5 mm. Costa with 2 parallel rows of dark short spines as well as dark hairs. Subcosta with dark hairs except near apex bare. Hair tuft on stem vein dark. Basal portion of radius bare.  $R_1$  with dark spinules and hairs.  $R_2$  with dark hairs only. Basal cell, and basal median cell absent. **Abdomen.** Basal scale dark brown, with fringe of long hairs. Dorsal surface of abdomen dark brown to brownish-black except middle portion of tergite 2 and whole of tergites 3–5 medium brown, sparsely to moderately covered with dark short hairs; tergite 2 with pair of silvery dorsolateral patches widely connected to each other medially when illuminated at certain angle of light, and tergites 6–8 shiny; 3 pairs of grey dorsolateral patches each covering inter-segmental areas between segments 3 and 4, between segments 4 and 5 and between seg-

ments 5 and 6 when illuminated at certain angle of light; ventral surface of abdomen dark greyish-brown to brownish-black; segment 7 without sternal plate. **Genitalia.** Sternite 8 (Fig. 1F) wide, bare medially but furnished with 22–26 short to long hairs on each side. Ovipositor valve (Fig. 1F) nearly triangular, with posteromedial apex rounded, thin, membranous, densely covered with microsetae interspersed with 18–20 short or medium-long hairs; inner margins concave, widely separated from each other. Genital fork (Fig. 1G) inverted-Y-shaped, with well sclerotized stem and with incision between arms; arm of moderate width, with distinct well sclerotized projection directed anterodorsally on dorsal surface. Paraproct (Fig. 1H,I) of usual shape, without any depression on ventral surface, moderately protruding ventrally, with 18–20 short and medium-long hairs on ventral and lateral surfaces, and with 11–15 spinous colorless sensilla on moderately sclerotized anteromedial surface. Cercus in lateral view (Fig. 1I) short, 0.53 times as long as wide, and 0.68 times as long as

paraproct, and rounded posteriorly. Spermatheca (Fig. 1J) ovoidal, strongly sclerotized except area around its juncture with duct unsclerotized, with obscure reticulate surface pattern, and with numerous internal setae; accessory ducts subequal in diameter to each other and also to main duct.

**Pupa.** Body length 3.3 mm. **Head.** Integument including antennal sheaths dark yellow to light brown, densely covered with small round tubercles; frons with 2 simple short trichomes arising close together on each side, face with 1 simple long trichome (about 2.3 times as long as frontal trichomes) on each side. **Thorax.** Integument (Fig. 2) dark yellow to light brown, densely covered with small round tubercles, with 3 long trichomes with 3 or 4 branches mediodorsally, 2 long trichomes with 3 or 4 branches mediolaterally, 1 simple medium-long trichome posterolaterally, and 3 simple or bifid medium-long trichomes ventrolaterally, on each side. Gill (Fig. 2) of arborescent type, with 38 slender thread-like filaments of different lengths (longest filament about 1.3 mm); all filaments light brown, with annular ridges and furrows irregularly, and densely covered with minute tubercles. **Abdomen.** Dorsally, segments 1 and 2 weakly sclerotized, yellowish or yellowish-brown and moderately tuberculate; segment 1 with 1 simple dark medium-long hair on each side; segment 2 with 1 simple dark medium-long hair, 1 simple short spinous seta and 4 simple dark short spines on each side; segments 3 and 4 very weakly sclerotized and yellowish along anterior margin, each with 4 dark stout hooks and 1 or 2 simple short spinous setae on each side; segments 5–7 and 9 lacking spine-combs; segment 8 with distinct spine-combs in transverse row on each side; terminal hooks absent. Ventrally, all segments nearly transparent; segment 5 with pair of 2 bifid dark hooks and 2 simple short setae on each side; segments 6 and 7 each with pair of bifid inner and simple outer hooks and 2 simple short setae on each side. **Cocoon.** Shoe-shaped, compactly woven, without open spaces in webs, and not extending ventrolaterally; anterior margin broken; individual threads invisible; 4.5 mm long by 1.5 mm wide; height of anteroventral collar about 1.0 mm.

**Male and Mature larva.** Unknown.

**TYPE SPECIMEN.** Holotype female (emerged from a pupa) with its associated pupal exuviae and cocoon, collected from a stream at Sumigar Bridge, along the road from Banaue to Abatan, Ifugao province, Luzon Island, Philippines, 1.VIII. 1999, by H. Takaoka and A. Takaoka.

**ECOLOGICAL NOTES.** The pupa of this new species was found on the slender root of a trailing grass in a mountainous stream (width 2–5 m, water temperature 18°C, exposed to sun, altitude 1,640 m) with moderate flow. Associated species was *Simulium* (*Simulium*) *abatanense* Takaoka.

**ETYMOLOGY.** The specific name *arboreum* is based on the Latin adjective “arboreus” meaning “treelike”, with spelling changed to “arboreum” to conform with the neuter gender of *Simulium*, and it refers to the arborescent type of pupal gill.

**REMARKS.** *Simulium* (*Simulium*) *arboreum* sp. nov. is readily assigned to the subgenus *Simulium* s. str., redefined by Takaoka (2003), by having a combination of the following characteristics: in the female, frons shiny and almost bare, cibarium with several minute tubercles, both katepisternum and pleural membrane bare, basal portion of the radial vein bare, claw with a small subbasal tooth, tergites 6–8 shiny, paraproct without a cluster of dark spines anteromedially; in the pupa, frons with two trichomes on each side, eighth abdominal segment with spine-combs, and terminal hooks absent.

*Simulium* (S.) *arboreum* sp. nov. is characterized by the pupal gill of an arborescent type consisting of 38 filaments (Fig. 2), a type also occurring very rarely in species of the genus *Simulium* s. l. in the Oriental and Australasian Regions. Such an arborescent type of the pupal gill has been reported only in the two species, i.e., *S. (Morops) papuense* Wharton from Papua New Guinea, Irian Jaya, Seram, Bougainville Island and Solomon Islands (Taka-

oka, 2003), and *S. (Asiosimulium) oblongum* Takaoka and Choochote from Thailand (Takaoka and Choochote, 2005).

The round ovipositor valves widely separated from each other, together with the claw with a small subbasal tooth and the non patterned scutum, relate this new species with *S. (S.) canlaonense* Delfinado from Negros Island, Philippines (Takaoka, 1983), *S. (S.) argentipes* Edwards from Peninsular Malaysia (Takaoka and Davies, 1995), *S. (S.) minangkabau* Takaoka and Sigit from Sumatra (Takaoka and Sigit, 1997), *S. (S.) beludense* Takaoka from Sabah (Takaoka, 1996), and *S. (S.) bidentatum* (Shiraki) from Japan and China (Takaoka, 1976). However, *S. (S.) arboreum* sp. nov. is distinguished from all these known species by the genital fork with an incision at the base of arms, and by the gill with 38 slender filaments (cf., all but the first two species, which are known only from females, have the pupal gill with 8–10 filaments).

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#### REFERENCES

- Takaoka, H. 1976. Studies on black flies of the Nansei Islands, Japan (Simuliidae; Diptera). II. On six species of the subgenera, *Gomphostilbia* Enderlein, *Morops* Enderlein, *Odagmia* Enderlein and *Gnus* Rubzov, with the description of *Simulium (Gomphostilbia) okinawense* sp. nov. *Jpn. J. Sanit. Zool.*, 27: 385–398.
- Takaoka, H. 1983. The Blackflies (Diptera: Simuliidae) of the Philippines. xi + 199 pp., Japan Society for the Promotion of Science, Tokyo.
- Takaoka, H. 1996. Description of a new species of *Simulium (Simulium)* from Sabah, Malaysia (Diptera: Simuliidae). *Jpn. J. Trop. Med. Hyg.*, 24: 157–161.
- Takaoka, H. 2000. A new black-fly species of *Simulium (Morops)* from Luzon Island, Philippines (Diptera: Simuliidae). *Jpn. J. Trop. Med. Hyg.*, 28: 361–364.
- Takaoka, H. 2003. The Black Flies (Diptera: Simuliidae) of Sulawesi, Maluku and Irian Jaya. xxii + 581 pp., Kyushu University Press, Fukuoka.
- Takaoka, H. 2005. A new species of *Simulium (Gomphostilbia)* from Luzon Island, Philippines (Diptera: Simuliidae). *Med. Entomol. Zool.*, 56: 211–218.
- Takaoka, H. and Choochote, W. 2005. A new subgenus and a new species of *Simulium* s. l. (Diptera: Simuliidae) from Thailand. *Med. Entomol. Zool.*, 56: 33–41.
- Takaoka, H. and Davies, D. M. 1995. The Black Flies (Diptera: Simuliidae) of West Malaysia. viii + 175 pp., Kyushu University Press, Fukuoka.
- Takaoka, H. and Sigit, S.H. 1997. Three new black-fly species of *Simulium* (Diptera: Simuliidae) from Sumatra, Indonesia. *Jpn. J. Trop. Med. Hyg.*, 25: 69–80.